Evaluation of an Artificial Rock Reef for Colonization by Macroalgae

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Abstract
We set out to measure the colonization and percent cover of a newly constructed rock reef by macroalgae. Rocks 1-2 feet in diameter were placed on a subtidal (-15 to -20 MLLW) mud bottom in order to mitigate for loss of macroalgal habitat. Diver video surveys were completed in the spring and summer following construction. Cover was estimated by randomly selecting 30 individual frames from the underwater video and the percent cover was assessed for each frame. An average percent cover for the 1000 square foot rock reef was obtained. This method is a quantitative, archival and verifiable method of estimating cover, and can provide a reliable and cost effective method for documenting habitat.

Introduction
A 1000-square-foot layer of granite boulders was placed on soft sediment. This was a mitigation action aimed at establishing habitat for kelp and macroalgae that would be disturbed by dredging activities. In order to satisfy permitting requirements the rock reef needed to maintain a minimum cover of 25% of the surface by macroalgae during the five years of required monitoring.

Methods
The entire reef was recorded on video in the course of a single underwater excursion. The very homogeneous nature of the substrate (boulder size, depth, siltation, and water current) made such a random sampling design, rather than following predetermined and repeatable transects, statistically appropriate.

In the laboratory, video footage was transferred to the computer and saved in "imovie" format. Thirty random frames were selected for analysis. A selected frame was viewed on a computer screen and an algal percent cover estimate generated. If an image was blurred or otherwise difficult to interpret the frame was rejected and another randomly selected.

Results
The rock finger was deposited on soft sediment on February 8, 2001. Two months later, April 3, 2001 the rock finger had a layer of diatoms but no other visible algae (Figure 1). Almost 7 months after the bare rock was deposited,August 30, 2001, there was 70% of the rock covered by species of red, green and brown algae (Figure 2). The largest area was covered by *Laminaria groenlandica* (Figure 2). During sampling the next summer, May 2002, the percent algal cover had increased to 99.1%. Keep in mind these are just surface measurements and no account was attempted of the multiple layers of kelp (Figure 3). By September 13, 2002 we recorded the first decrease in percent cover with more bare rock showing and an increase in green and red algae, the percent cover was 77% (Figure 4). The record in year two of five shows a dramatic colonization of the bare rock reef and the first signs of decline (Figure 5).

Discussion
A visual estimate of percent cover is an accepted method of rapidly and accurately generating two-dimensional cover data (Dethier 1993). Video-graphic analysis has distinct advantages over *in situ* measurements of percent cover. It requires a relatively short investment of time gathering images and is thus logistically and financially economical. However, these cover estimates are under estimates. This method cannot distinguish greater than 100% cover (as when kelp blades are layered on top of each other). Also, while total algal percent cover is easily obtained, it is difficult to distinguish between algal species.

References
Dehtier, M. N., E. S. Graham, S. Cohen, L. M. Tear. 1993. Visual versus random-point percent cover estimation: 'objective' is not always better. Marine Ecological Progress Series 93:92-100.

Figure 1. April 3, 2001- Rock deposited at site February 8, by April diatoms are present.

Figure 2. August 30, 2001 –Colonization has begun with 70% cover after 6 months.

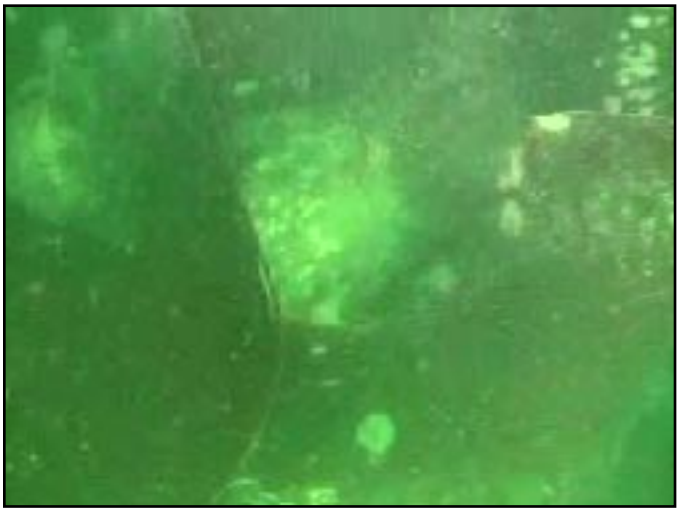

Figure 3. May 23, 2002 – After one year there is 99.1% cover.

[Editor's note: No graphic available for Figure 4.]
Figure 4. September 13, 2002. More rock visible and an increase in red and green algae. Percent cover reduced to 77%.

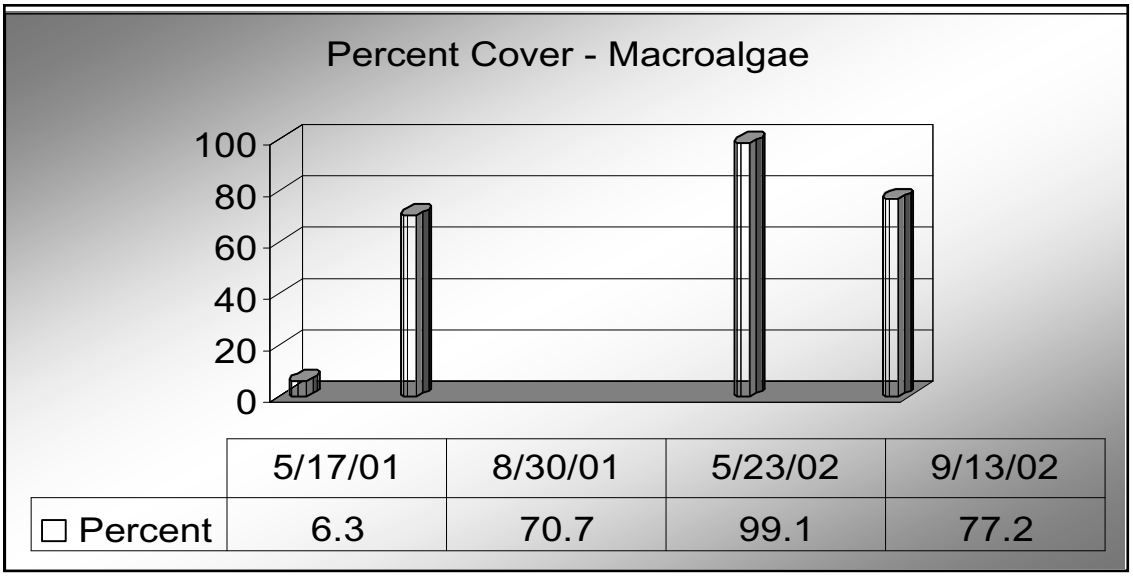

Figure 5. The trend in colonization over a two year period was a dramatic increase during year one and a slight decline by the end of the second summer. Overall percent cover remained above the targeted 25% after the first two years of monitoring.